FINAL REPORT

NASA COOPERATIVE AGREEMENT NCC 2-866

TITLE: Physiological Anatomical Rodent Experiment (PARE).04 Flight Support

SUBMITTED TO:
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BRIEF SUMMARY:

Rats were shipped to Kennedy Space Center (KSC), Florida, on day 2 of gestation [(G2) (day 1 = morning on which spermatozoa are present in the vagina)] and laparotomized on G7 to determine the number of implantation sites in each uterine horn. On G8, ten pregnant rats meeting flight criteria (at least five implantation sites each horn) were placed into NASA flight cages (animal enclosure modules, AEMs, five rats per cage), loaded onto the mid-deck of the space shuttle Atlantis, and on G9 (November 3, 1994) they were launched into orbit. On gestation day 20, (November 14, 1994) the shuttle returned to Edwards Air Force Base, California and the flight animals were recovered from the shuttle and subjected to unilateral hysterectomy to provide fetal material from one horn to investigators identified by NASA to study selected fetal parameters. After unilateral hysterectomy, the animals were allowed to recover and deliver vaginally. There were three groups (n=10 each group) of control animals housed at KSC in the study. A synchronous control group, delayed 24 hours with reference to the flight group, received the same surgeries and was housed five rats per AEM and exposed to all flight conditions (identical temperatures, lighting and humidity) except microgravity. Vivarium control group 1 did not receive any surgery and was housed in the vivarium in clear polycarbonate cages. Vivarium control group 2 received only a unilateral hysterectomy on day 20 of gestation but otherwise was housed like the vivarium control group 1. Control groups were allowed to complete their pregnancy and deliver fetuses from the remaining horn (Synchronous control and vivarium control group 2) or horns (Vivarium control group 1). After surgery, the dams were euthanized and tissues recovered, and the neonates were assigned to foster dams.

GENERAL OVERVIEW OF RESULTS:

1. There was no effect of laparotomy at gestation day 7 on the maintenance of pregnancy to term. The addition of a second surgery, unilateral hysterectomy at gestation day 20, also had no effect on vaginal delivery at G22 or 23. Space flight had no effect on the maintenance of gestation during days 9-20 and unilateral hysterectomy had no effect on delivery of pups from the remaining horn of flight animals.

2. During the interval between liftoff (G9) and recovery (G20), space flight had no effect on the per cent gain in body mass.

Our specific analysis focused on the examination of the effects of space flight on the postpartum fecundity ratio and numbers of healthy and atretic ovarian antral follicles. In addition, the concentration of plasma progesterone, LH, and FSH and the pituitary content of LH and FSH was evaluated.

1. Space flight had no effect on the mass of the dam's pituitary gland or ovaries.

2. Space flight had no effect on the percent of healthy or atretic ovarian follicles 201-400μm, 401-570μm, or greater than 570μm (preovulatory).

3. Space flight had no effect on the plasma concentration of progesterone.

4. Space flight had no effect on the plasma concentration of LH, but significantly increased ($p< 0.04$) FSH concentrations.

5. Space flight significantly decreased ($p<0.02$) the pituitary content of LH but had no effect on the content of FSH.

6. There was no effect of space flight on the ratio of the number of ovarian corpora lutea at term to the number of live conceptuses at G20 plus term (fecundity ratio). This shows that space flight during G9-G20 did not alter the usual rate of fetal wastage during this interval of pregnancy.

GENERAL IMPLICATIONS OF RESULTS:

The results from this study employing rats show that space flight does not adversely affect pregnancy when flight commences during the post-implantation period (day 9), after pregnancy is well established. In addition, when space flight concludes on day 20, and the animals have 2-3 days to acclimate to earth's gravity, vaginal delivery occurs. Space flight during post-implantation pregnancy does not appear to alter hypophyseal-ovarian function.

PUBLICATIONS:

Burden, HW, Zary, J, Lawrence, IE, Jonnalagadda, P, Church, M, Hodson, C: Hypophyseal-ovarian function in rat dams flown on the NIH.R1 study. ASGSB Bulletin 1995;9(1), 98.

Burden, HW, Zary, J, Lawrence, IE, Jonnalagadda, P, Davis, M, Hodson, CA: Effects of spaceflight on ovarian-hypophyseal function in postpartum rats. Jour. Reprod. Fert. 1997;109(2): 193-197.